Modelling Spatial Spread of Genetic Information via Pollen Dispersal: Coupling of Population Dynamics and Genetics

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Abstract: Unintended spatial spread of genetic information is one major problem in modern agriculture. This concerns vertical distribution of transgenic properties as well as spatial spread of resistant biotypes of weeds and pests, which are likely to develop under long-term pesticide Unintended spatial spread of genetic information is one major problem in modern agriculture. This concerns vertical distribution of transgenic properties as well as spatial spread of resistant biotypes of weeds and pests, which are likely to develop under long-term pesticide use. These systems are complex and require an integrated view at population dynamics-and genetics and at physical transport processes. Mathematical models, which describe these processes in a concise and consistent way may support the steps of risk assessment and help to derive appropriate risk management strategies. Partial differential equations are an appropriate mathematical framework to model these systems at an aggregated level. Pollen dispersal is modelled by use of the familiar transport equations from atmospheric physics, which are applied to data of outcrossing studies of genetically modified maize. For further development of the theory, transport equations are coupled with population dynamic and genetic models casted into partial differential equations combining dispersal, growth and genetics. The resulting model consists of a set of coupled partial differential equations for pollen dispersal and the spatial temporal dynamics of each biotype involved. Initial boundary value problems are set up for the dispersal of resistance in dependence on spatial spray patterns, which are solved by finite element methods.

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